[0019] FIG. 3A is a flowchart 300A of a battery management method according to an embodiment of the disclosure;

[0020] FIG. 3B is a flowchart 300B of a battery management method according to another embodiment of the disclosure;

[0021] FIG. 4A is a flowchart 400A of a battery management method according to an embodiment of the disclosure;

[0022] FIG. 4B is a flowchart 400B of a battery management method according to another embodiment of the disclosure.

DESCRIPTION OF THE EMBODIMENTS

[0023] This description is made for the purpose of illustrating the general principles of the disclosure and should not be taken in a limiting sense. The scope of the disclosure is best determined by reference to the appended claims.

[0024] FIG. 1A is a block diagram illustrating the battery management system **100** in a discharged state according to an embodiment of the disclosure. As shown in FIG. 1A, the battery management system **100** comprises a plurality of battery devices **110-1**~**110**-N, wherein the battery devices **110-1**~**110**-N are connected in parallel. Each of the battery devices **110-1**~**110**-N comprises one or a plurality of battery units **111**, a switch circuit **112**, and a controller **113**. When the battery management system **100** is in the discharged state, the battery management system **100** may connect with a load **120** to provide power to the load **120**. It should be noted that the block diagram shown in FIG. 1A is for the purpose of simplicity and clarity. However, the disclosure should not be limited to what is shown in FIG. 1A. Each of the battery devices **110-1**~**110**-N can also comprise other elements. In addition, it should be noted that, in order to conveniently illustrate the embodiments the disclosure, all of the battery units, the switch circuits, and the controllers for each of the battery devices **110-1**~**110**-N are indicated as the battery units **111**, the switch circuit **112**, and the controller **113**. However, it does not mean that they are the same elements in the battery management system **100**.

[0025] FIG. 1B is a block diagram illustrating the battery management system **100** in a charged state according to an embodiment of the disclosure. As shown in FIG. 1B, when the battery management system **100** is in the charged state, the battery management system **100** may connect with a charging device **130** to charge the battery management system **100**. It should be noted that the block diagram shown in FIG. 1B is for the purpose of simplicity and clarity. However, the disclosure should not be limited to what is shown in FIG. 1B. Each of the battery devices **110-1**~**110**-N can also comprise other elements.

[0026] In an embodiment of the disclosure, the battery units **111** are configured to provide power. The switch circuit **112** is composed by two Metal-Oxide-Semiconductor Field-Effect Transistor (MOSFET), and is configured to open or close the battery devices **110-1**~**110**-N. The controller **113** is configured to enable or disable the switch circuit **112** to determine whether to open or close the battery devices **110-1**~**110**-N. In some embodiments of the disclosure, the controller **113** may be an electrical device, a processor, or a chip.

[0027] In the battery devices **110-1**~**110**-N which are connected in parallel, because some battery devices are new and some battery devices are old, each of the battery devices **110-1**~**110**-N may have different respective electric quantities. Therefore, when the battery devices **110-1**~**110**-N do not achieve a balanced state, a battery device which has a higher electric quantity may charge a battery device which has a lower electric quantity, and as a result, a reverse current may be generated.

[0028] In an embodiment of the disclosure, the controller **113** is configured to detect a reverse current, i.e. the controller **113** may determine whether the flow direction of the current conforms to the present state (e.g. a discharged state or a charged state). For example, if the battery management system **100** is in a charged state, when a current which has a discharge direction (e.g. the direction from the battery units **111** to the load **120**) is generated, the controller **113** will determine that a reverse current has occurred, or if the battery management system **100** is in a discharged state, when a current which has charge direction (e.g. the direction from the charging device **130** to the battery units **111**) is generated, the controller **113** will determine that a reverse current has occurred. When the battery devices **110-1**~**110**-N have been enabled, the controller **113** of each battery devices **110-1**~**110**-N may detect whether a reverse current is generated. When the controller **113** detects a reverse current, the controller **113** will disable the switch circuit **112** to close the battery device corresponding to this controller **113**. Then, the controller **113** will perform a judgment mechanism to determine whether to re-enable the switch circuit **112**. For example, when the controller **113** of the battery device **110-1** detects a reverse current, the controller **113** will disable the switch circuit **112** to close the battery device **110-1**.

[0029] In an embodiment of the disclosure, the judgment mechanism indicates that the controller may detect whether a terminal voltage difference value is greater than a first threshold. When the terminal voltage difference value is greater than the first threshold, the controller **113** will re-enable the switch circuit **112** to enable the battery device corresponding to this controller **113**. When the terminal voltage difference value is lower than or equal to the first threshold, the controller **113** will re-detect whether the terminal voltage difference value is greater than the first threshold until the battery devices **110-1**~**110**-N achieve a balanced state. In an embodiment of the disclosure, the first threshold may be a default value which is lower than a maximum voltage value of the battery devices **110-1**~**110**-N.

[0030] In an embodiment of the disclosure, when the battery management system **100** is in the discharged state, the terminal voltage difference value is regarded as a voltage difference value between the terminal voltages of the battery units **111** and the load **120**. As shown in FIG. 1A, in the embodiment of the disclosure, the terminal voltage difference value is regarded as a voltage difference value between the terminal voltage V_c of the battery units **111** and the terminal voltage V_o of the load **120**. In another embodiment of the disclosure, when the battery management system **100** is in a discharged state, the terminal voltage difference value is regarded as the voltage difference value between the first voltage value and the second voltage value, wherein the first voltage value and the second voltage value are meant to be the voltage values of the load **120** at different points in time. As shown in FIG. 1B, in the embodiment of the disclosure, the terminal voltage difference value is regarded as the voltage difference value between the first voltage value corresponding to the terminal voltage V_o of the load **120** at the first time point and the second voltage value corresponding to the terminal voltage V_o of the load **120** at the second time point.